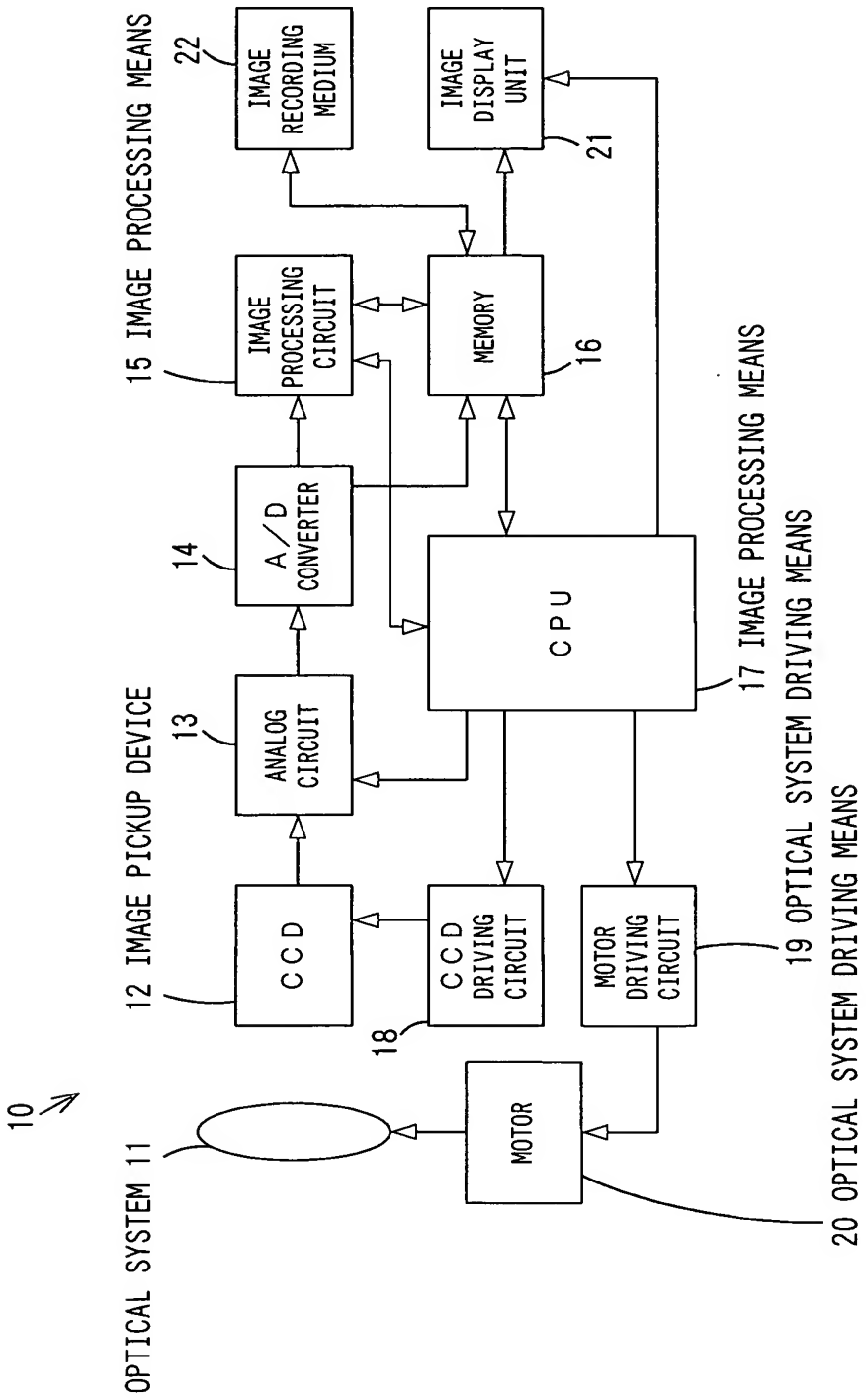

10
OPTICAL SYSTEM 11
12 IMAGE PICKUP DEVICE
CCD
13
ANALOG CIRCUIT
14
A／D CONVERTER
15 IMAGE PROCESSING MEANS
IMAGE PROCESSING CIRCUIT
IMAGE RECORDING MEDIUM
22
MEMORY
16
IMAGE DISPLAY UNIT
21
17 IMAGE PROCESSING MEANS
CPU
18
CCD DRIVING CIRCUIT
19 OPTICAL SYSTEM DRIVING MEANS
MOTOR DRIVING CIRCUIT
20 OPTICAL SYSTEM DRIVING MEANS
MOTOR

FIG. 1

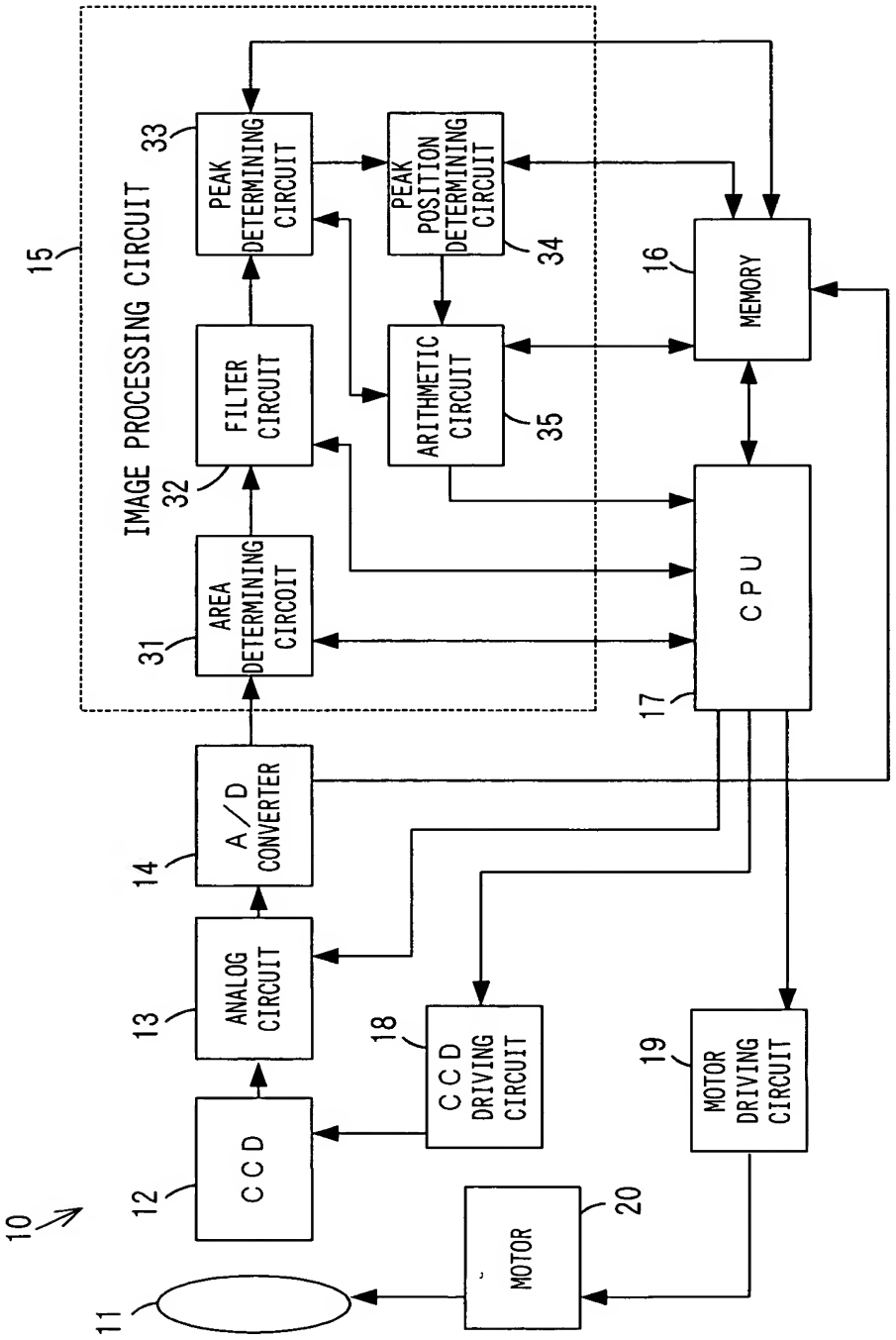

10
11
12
CCD
13
ANALOG CIRCUIT
14
A/D CONVERTER
15
IMAGE PROCESSING CIRCUIT
31
AREA DETERMINING CIRCOIT
32
FILTER CIRCUIT
33
PEAK DETERMINING CIRCUIT
34
PEAK POSITION DETERMINING CIRCUIT
35
ARITHMETIC CIRCUIT
16
MEMORY
17
CPU
18
CCD DRIVING CIRCUIT
19
MOTOR DRIVING CIRCUIT
20
MOTOR

FIG. 2

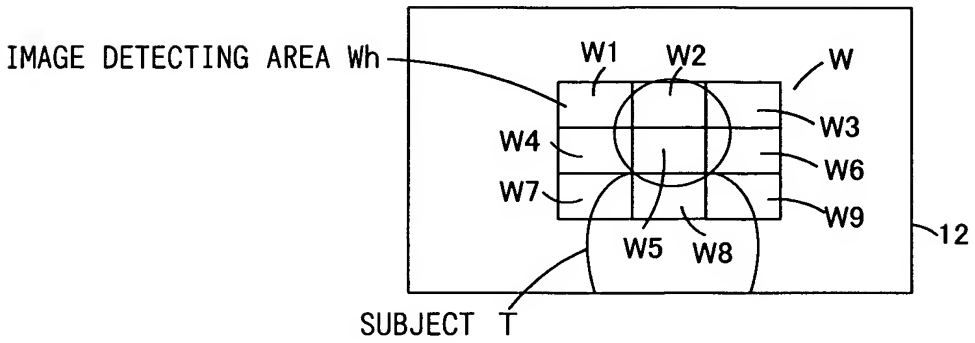
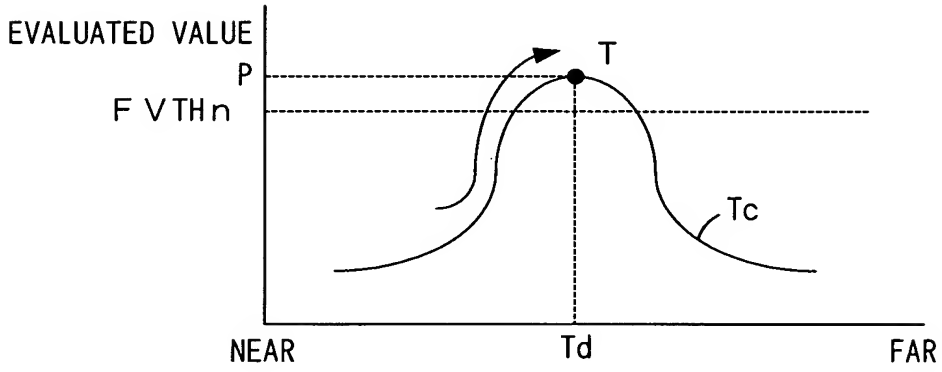


IMAGE DETECTING AREA Wh
W1
W2
W
W3
W4
W6
W7
W9
W5
W8
12
SUBJECT T

(a)


EVALUATED VALUE
P
F V TH n
T
Tc
NEAR
Td
FAR

(b)

FIG. 3

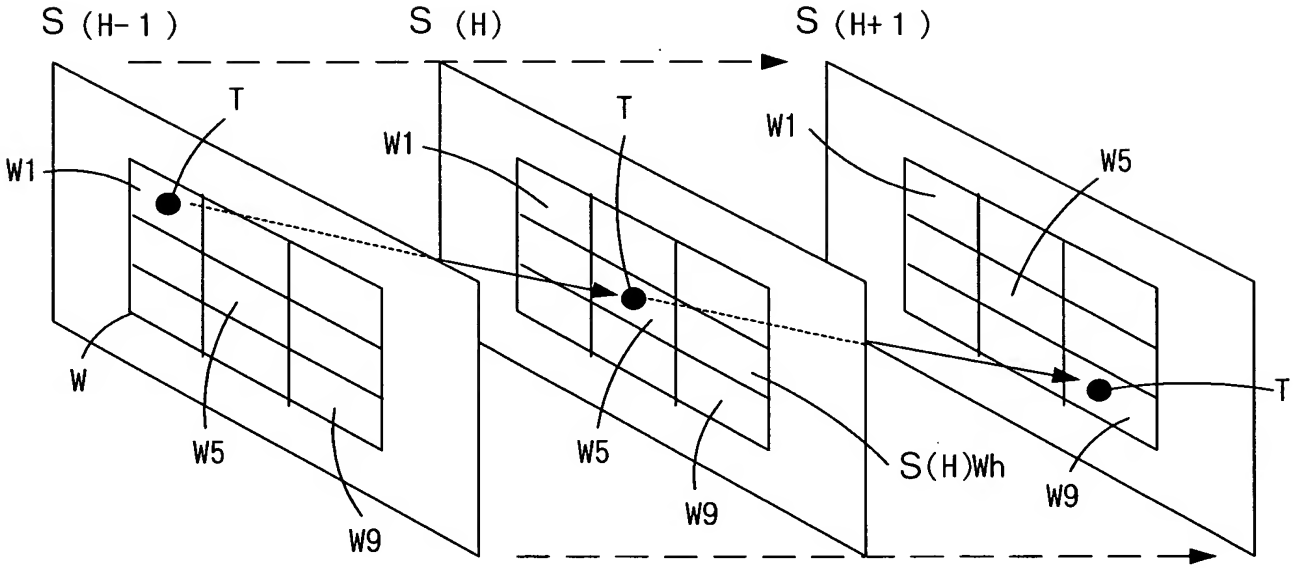
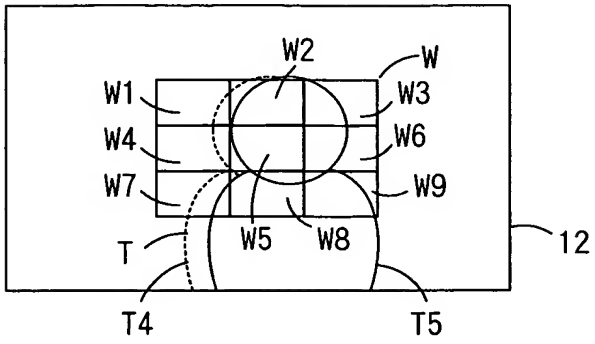
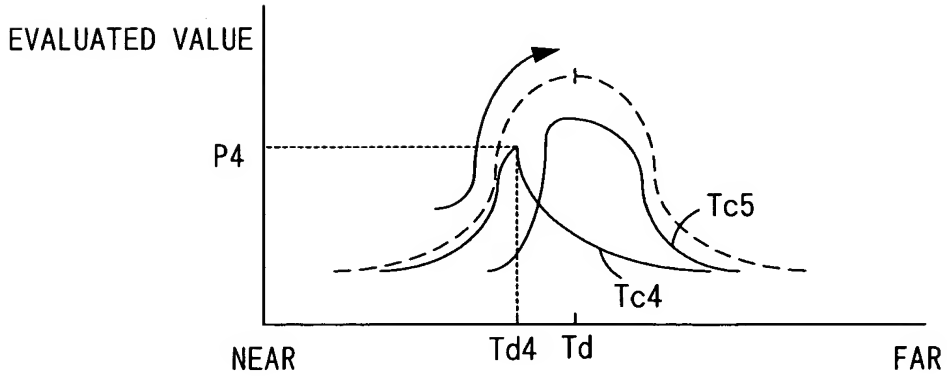


FIG. 4


W2
W
W1
W3
W4
W6
W7
W9
W5
W8
12
T
T4
T5

(a)


EVALUATED VALUE
P4
Tc5
Tc4
NEAR
Td4
Td
FAR

(b)

FIG. 5

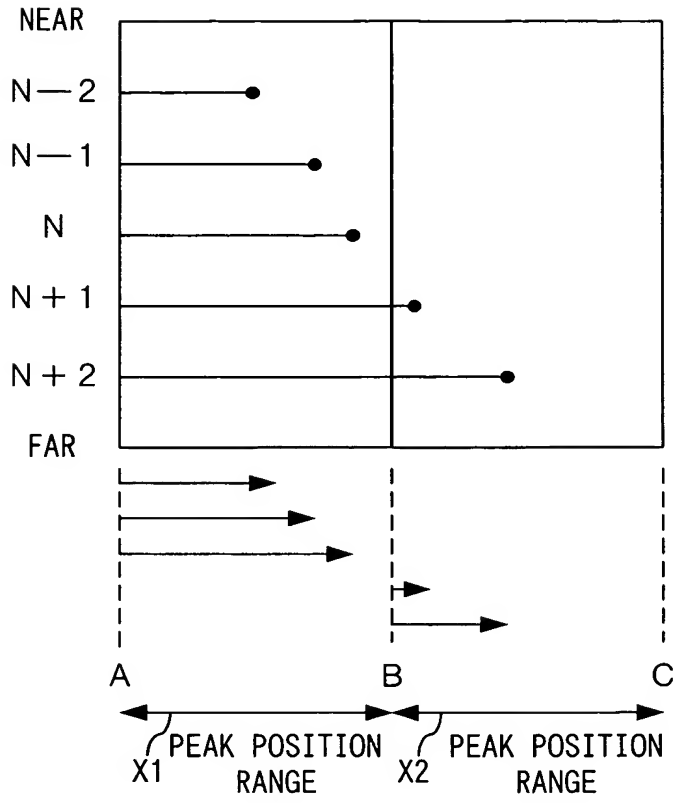

NEAR
N—2
N—1
N
N+1
N+2
FAR
A
B
C
X1
PEAK POSITION RANGE
X2
PEAK POSITION RANGE

FIG. 6

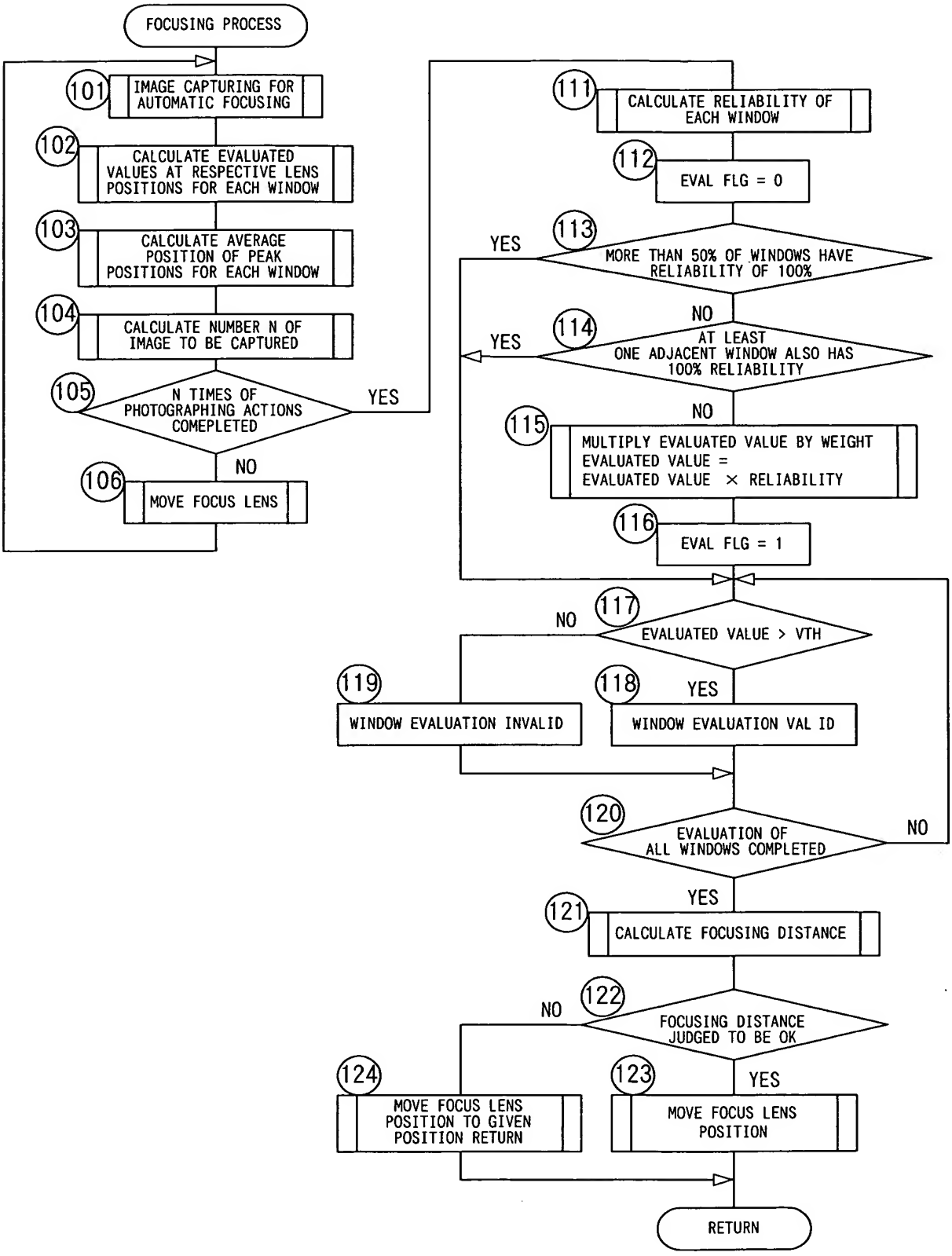

FOCUSING PROCESS
101
IMAGE CAPTURING FOR AUTOMATIC FOCUSING
102
CALCULATE EVALUATED VALUES AT RESPECTIVE LENS POSITIONS FOR EACH WINDOW
103
CALCULATE AVERAGE POSITION OF PEAK POSITIONS FOR EACH WINDOW
104
CALCULATE NUMBER N OF IMAGE TO BE CAPTURED
105
N TIMES OF PHOTOGRAPHING ACTIONS COMEPLETED
YES
NO
106
MOVE FOCUS LENS
111
CALCULATE RELIABILITY OF EACH WINDOW
112
EVAL FLG = 0
113
MORE THAN 50% OF WINDOWS HAVE RELIABILITY OF 100%
YES
NO
114
AT LEAST ONE ADJACENT WINDOW ALSO HAS 100% RELIABILITY
YES
NO
115
MULTIPLY EVALUATED VALUE BY WEIGHT
EVALUATED VALUE =
EVALUATED VALUE × RELIABILITY
116
EVAL FLG = 1
117
EVALUATED VALUE > VTH
NO
YES
118
WINDOW EVALUATION VAL ID
119
WINDOW EVALUATION INVALID
120
EVALUATION OF ALL WINDOWS COMPLETED
NO
YES
121
CALCULATE FOCUSING DISTANCE
122
FOCUSING DISTANCE JUDGED TO BE OK
NO
YES
123
MOVE FOCUS LENS POSITION
124
MOVE FOCUS LENS POSITION TO GIVEN POSITION RETURN
RETURN

FIG. 7

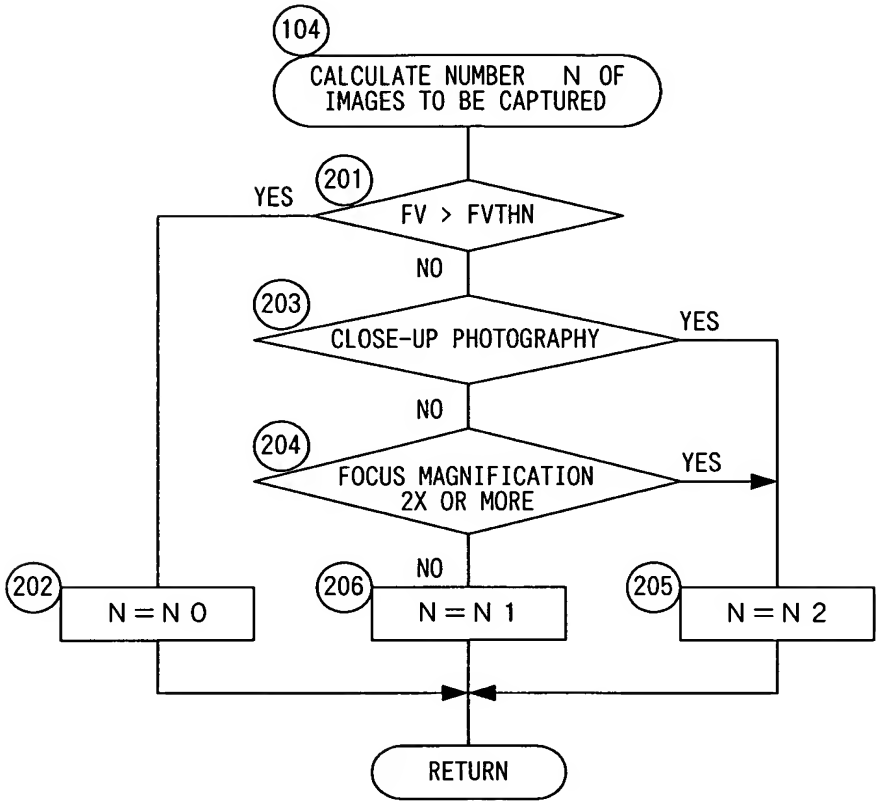

104
CALCULATE NUMBER N OF IMAGES TO BE CAPTURED
201
FV > FVTHN
YES
NO
203
CLOSE-UP PHOTOGRAPHY
YES
NO
204
FOCUS MAGNIFICATION 2X OR MORE
YES
NO
202
N = N 0
206
N = N 1
205
N = N 2
RETURN

FIG. 8

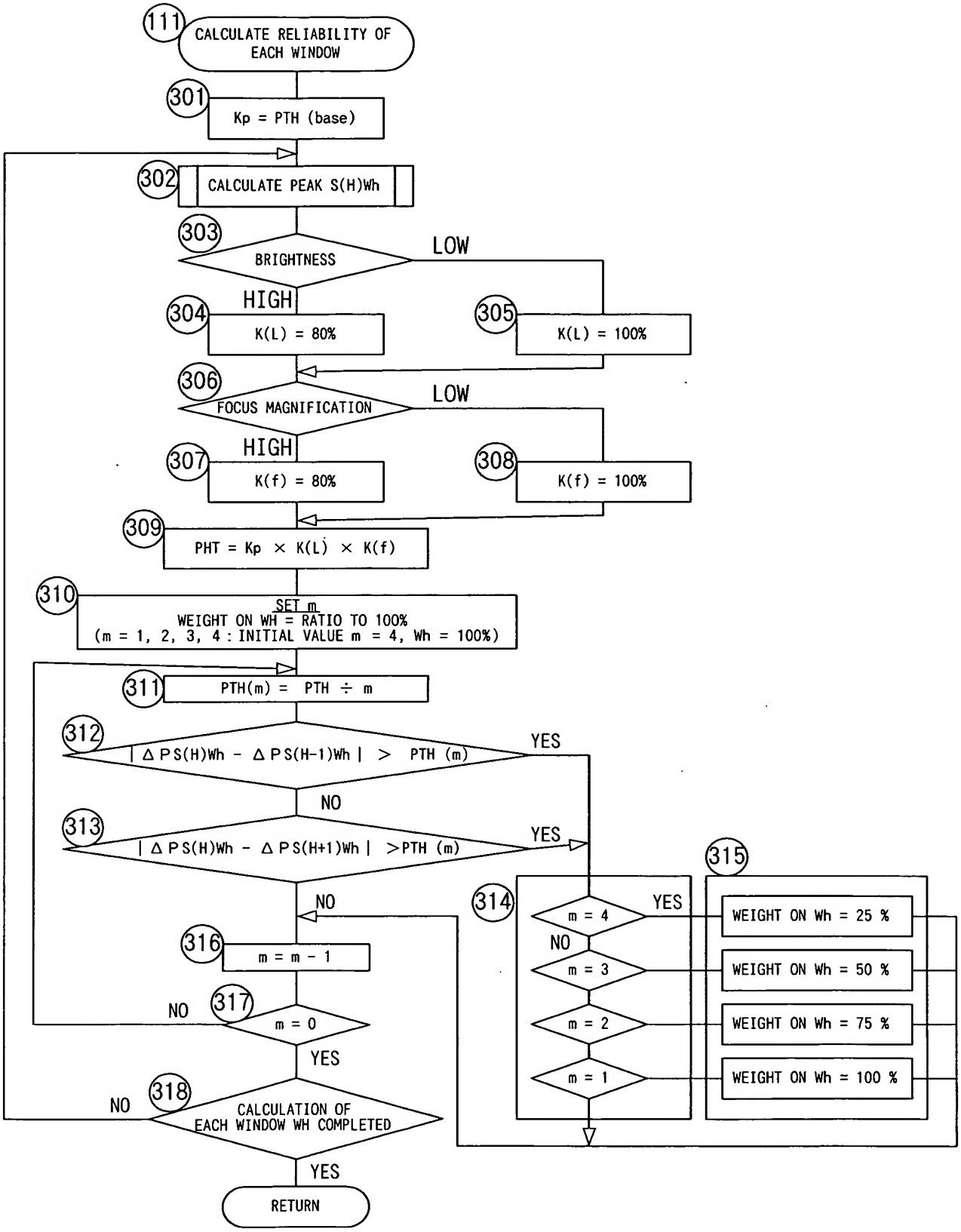

111
CALCULATE RELIABILITY OF EACH WINDOW
301
Kp = PTH (base)
302
CALCULATE PEAK S(H)Wh
303
BRIGHTNESS
LOW
HIGH
304
K(L) = 80%
305
K(L) = 100%
306
FOCUS MAGNIFICATION
LOW
HIGH
307
K(f) = 80%
308
K(f) = 100%
309
PHT = Kp × K(L) × K(f)
310
SET m
WEIGHT ON WH = RATIO TO 100%
(m = 1, 2, 3, 4 : INITIAL VALUE m = 4, Wh = 100%)
311
PTH(m) = PTH ÷ m
312
| ΔPS(H)Wh - ΔPS(H-1)Wh | > PTH (m)
YES
NO
313
| ΔPS(H)Wh - ΔPS(H+1)Wh | >PTH (m)
YES
NO
314
m = 4
YES
NO
m = 3
m = 2
m = 1
315
WEIGHT ON Wh = 25 %
WEIGHT ON Wh = 50 %
WEIGHT ON Wh = 75 %
WEIGHT ON Wh = 100 %
316
m = m - 1
317
m = 0
NO
YES
318
CALCULATION OF EACH WINDOW WH COMPLETED
NO
YES
RETURN

FIG. 9

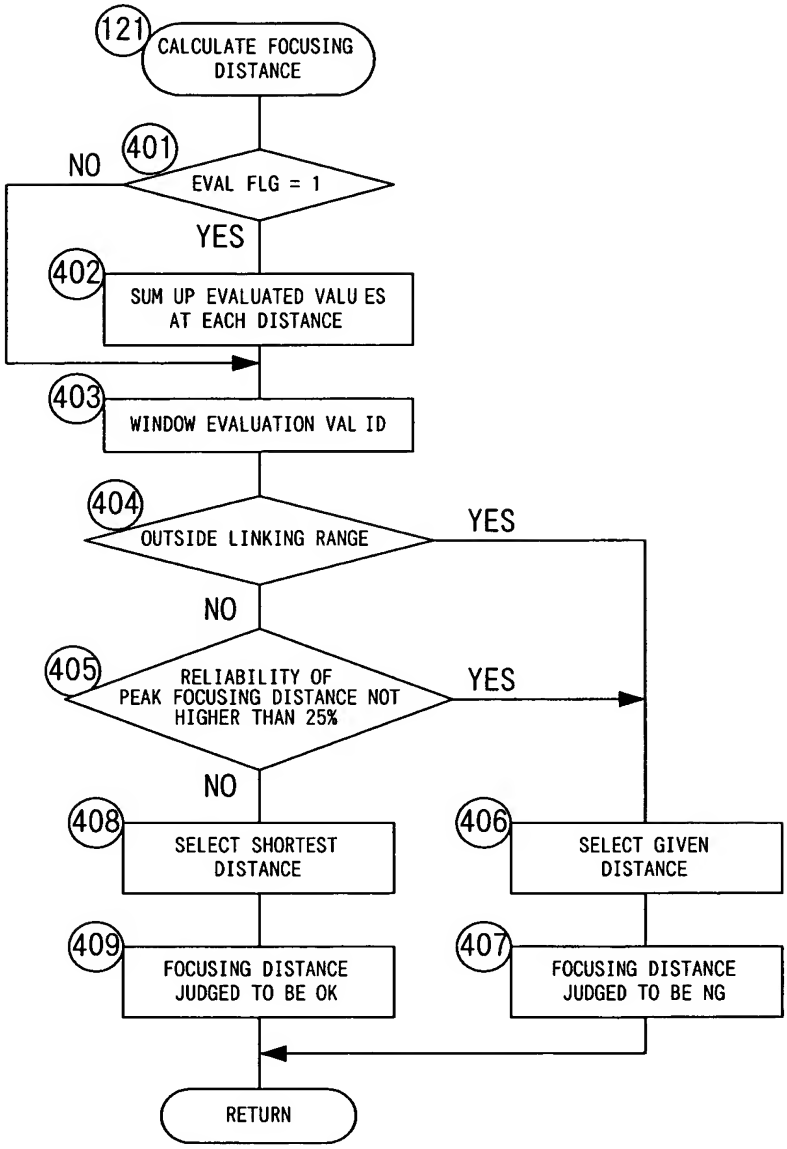

121
CALCULATE FOCUSING DISTANCE
401
NO
EVAL FLG = 1
YES
402
SUM UP EVALUATED VALU ES AT EACH DISTANCE
403
WINDOW EVALUATION VAL ID
404
OUTSIDE LINKING RANGE
YES
NO
405
RELIABILITY OF PEAK FOCUSING DISTANCE NOT HIGHER THAN 25%
YES
NO
408
SELECT SHORTEST DISTANCE
406
SELECT GIVEN DISTANCE
409
FOCUSING DISTANCE JUDGED TO BE OK
407
FOCUSING DISTANCE JUDGED TO BE NG
RETURN

FIG. 10

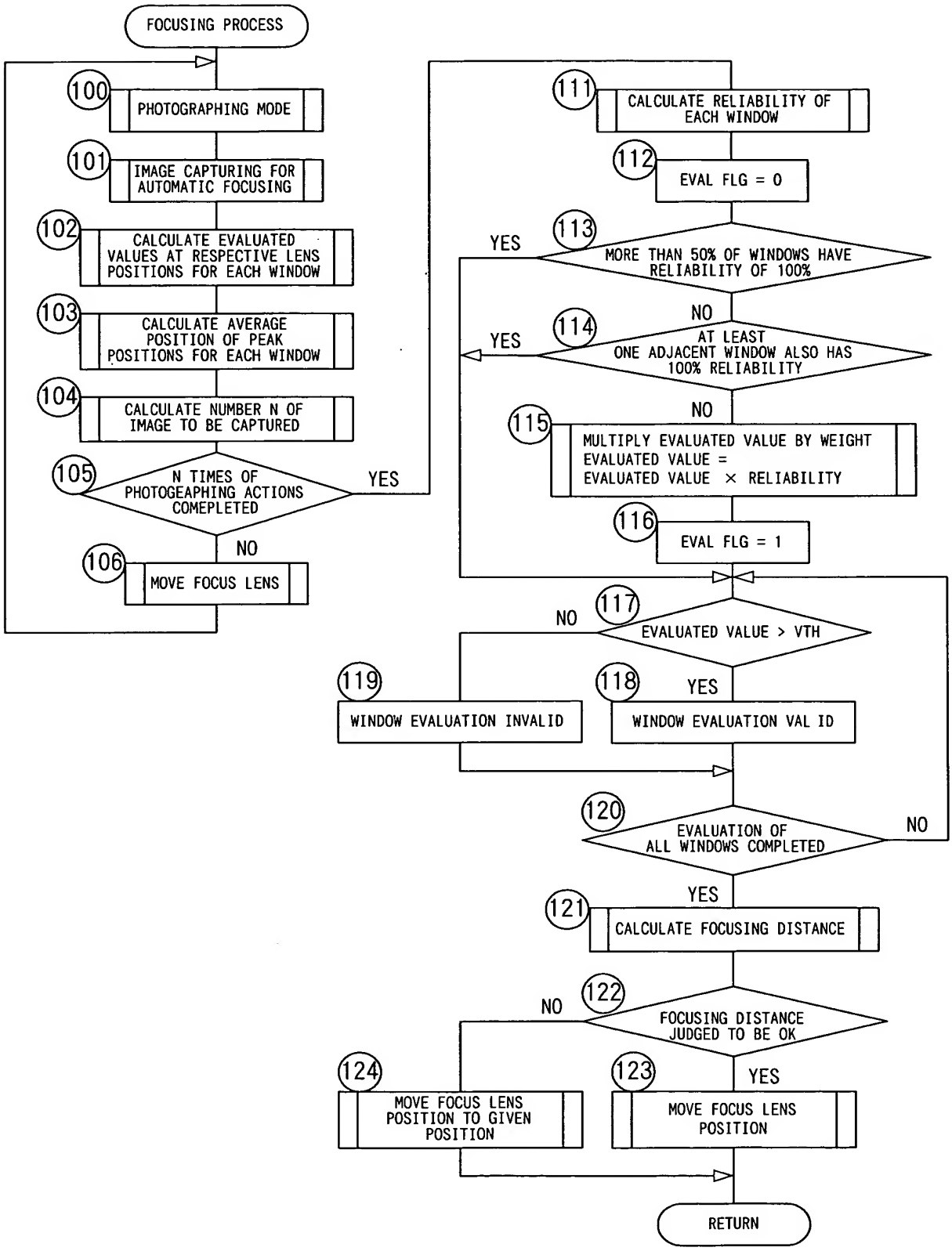

FOCUSING PROCESS
100
PHOTOGRAPHING MODE
101
IMAGE CAPTURING FOR AUTOMATIC FOCUSING
102
CALCULATE EVALUATED VALUES AT RESPECTIVE LENS POSITIONS FOR EACH WINDOW
103
CALCULATE AVERAGE POSITION OF PEAK POSITIONS FOR EACH WINDOW
104
CALCULATE NUMBER N OF IMAGE TO BE CAPTURED
105
N TIMES OF PHOTOGEAPHING ACTIONS COMEPLETED
YES
NO
106
MOVE FOCUS LENS
111
CALCULATE RELIABILITY OF EACH WINDOW
112
EVAL FLG = 0
113
MORE THAN 50% OF WINDOWS HAVE RELIABILITY OF 100%
YES
NO
114
AT LEAST ONE ADJACENT WINDOW ALSO HAS 100% RELIABILITY
YES
NO
115
MULTIPLY EVALUATED VALUE BY WEIGHT
EVALUATED VALUE =
EVALUATED VALUE × RELIABILITY
116
EVAL FLG = 1
117
EVALUATED VALUE > VTH
NO
YES
118
WINDOW EVALUATION VAL ID
119
WINDOW EVALUATION INVALID
120
EVALUATION OF ALL WINDOWS COMPLETED
NO
YES
121
CALCULATE FOCUSING DISTANCE
122
FOCUSING DISTANCE JUDGED TO BE OK
NO
YES
123
MOVE FOCUS LENS POSITION
124
MOVE FOCUS LENS POSITION TO GIVEN POSITION
RETURN

FIG. 11

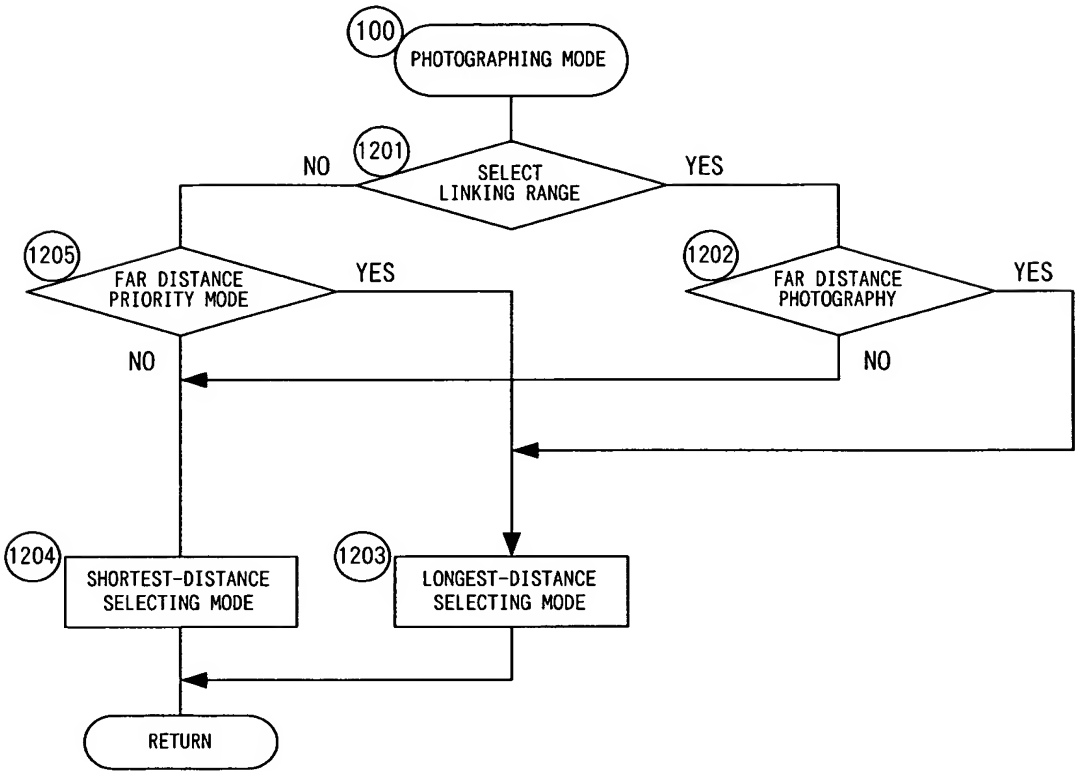

100
PHOTOGRAPHING MODE
1201
SELECT LINKING RANGE
NO
YES
1205
FAR DISTANCE PRIORITY MODE
YES
NO
1202
FAR DISTANCE PHOTOGRAPHY
YES
NO
1204
SHORTEST-DISTANCE SELECTING MODE
1203
LONGEST-DISTANCE SELECTING MODE
RETURN

FIG. 12

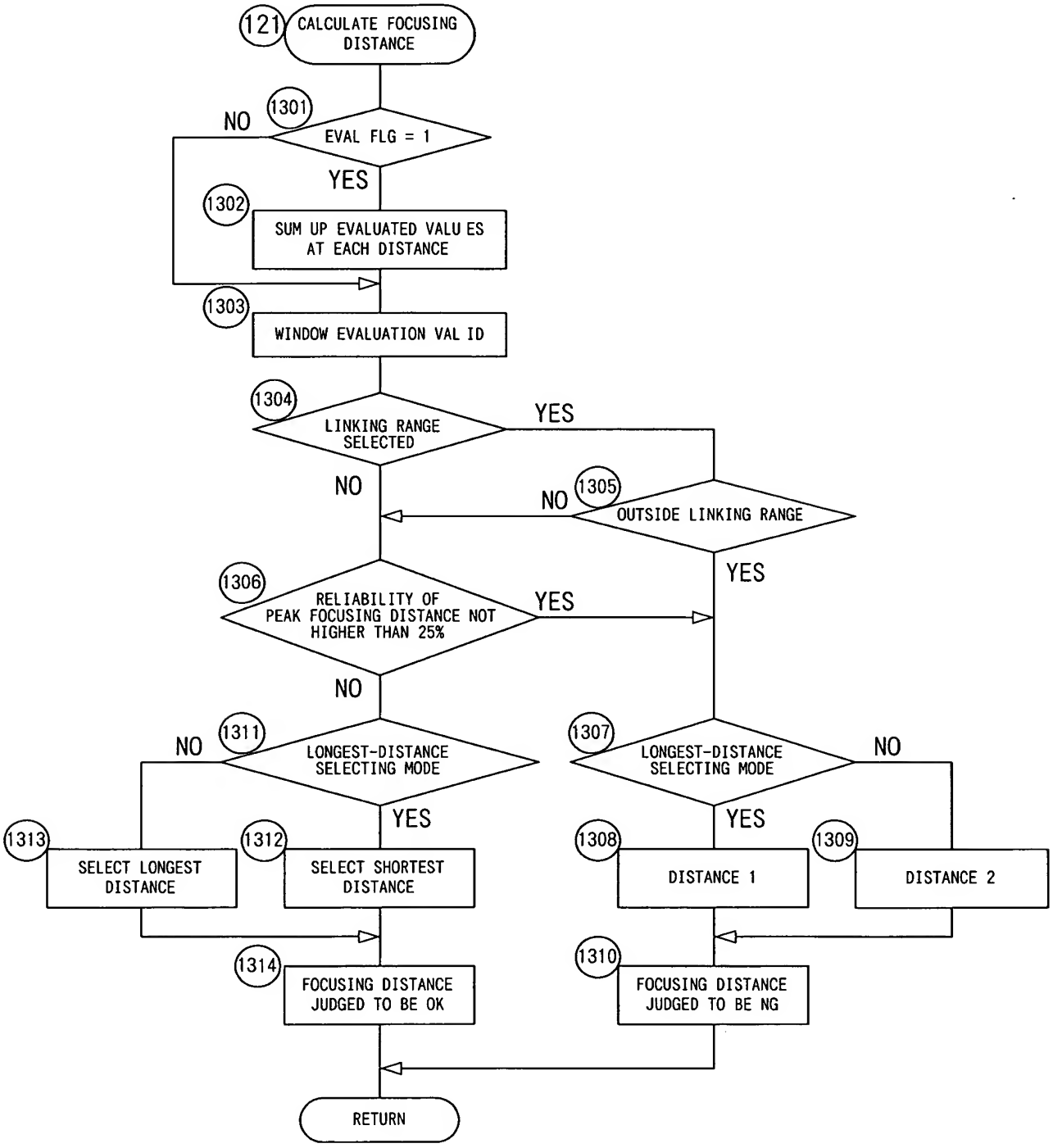

121
CALCULATE FOCUSING DISTANCE
1301
EVAL FLG = 1
NO
YES
1302
SUM UP EVALUATED VALU ES AT EACH DISTANCE
1303
WINDOW EVALUATION VAL ID
1304
LINKING RANGE SELECTED
YES
NO
1305
OUTSIDE LINKING RANGE
NO
YES
1306
RELIABILITY OF PEAK FOCUSING DISTANCE NOT HIGHER THAN 25%
YES
NO
1311
LONGEST-DISTANCE SELECTING MODE
NO
YES
1307
LONGEST-DISTANCE SELECTING MODE
NO
YES
1313
SELECT LONGEST DISTANCE
1312
SELECT SHORTEST DISTANCE
1308
DISTANCE 1
1309
DISTANCE 2
1314
FOCUSING DISTANCE JUDGED TO BE OK
1310
FOCUSING DISTANCE JUDGED TO BE NG
RETURN

FIG. 13